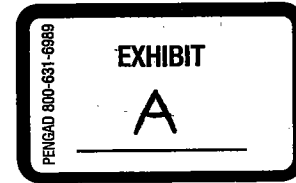


U.S. Patent Application No. 10/598,515

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the semiconductor device using the epoxy resin composition for semiconductor closure and it excellent in reliability.

[0002]

[Description of the Prior Art]Although semiconductor devices, such as a transistor, IC, and LSI, were conventionally closed and semiconductor-device-ized with the ceramic package etc., these days, the resin seal which used the plastic package from a viewpoint of cost and mass production nature is in use. The epoxy resin is used for this kind of resin seal from the former, and good results are stored in it. However, the minuteness making of large-sized-izing of element size and wiring progresses with improvement in a degree of location by the technical innovation of the semiconductor field, A package is also in the tendency miniaturized and thin-type-ized, and improvement in the above reliability (reduction of the heat stress of the semiconductor device obtained, humidity-tolerant reliability, reliability over a heat-resistant impact test, etc.) is demanded more to the sealing material in connection with this. It is large-sized-tended increasingly toize especially semiconductor device size, and improvement in the above performance is demanded [rather than] in recent years from the thermal cycling test (TCT test) which is an accelerated test which evaluates the performance of semiconductor sealing resin. The characteristic that neither a crack nor bulging occurs in a package even if it is immersed in solder melting liquid, after the surface mount had become in use as a mounting method of a semiconductor package, for this reason making a semiconductor package absorb moisture is demanded. Although denaturalizing an epoxy resin with a silicone compound and reducing heat stress for improvement in each characteristic conventionally evaluated by a TCT test about this is examined and improvement in adhesion with a leadframe, etc. have been considered for the improvement in crack resistance at the time of solder immersion, The effect

is not yet enough.

[0003]

[Problem(s) to be Solved by the Invention]As mentioned above, neither the result of a TCT test nor the crack resistant characteristic at the time of solder immersion of the old epoxy resin composition for closure was enough. For this reason, improvement in both the above-mentioned characteristics is strongly desired so that it can respond to large-sized-izing and surface-mount-izing of semiconductor device size by the above-mentioned technical innovation.

[0004]This invention was made in view of such a situation, and sets offer of the epoxy resin composition for semiconductor closure and a semiconductor device excellent in the crack resistance at the time of immersion in the improvement in each characteristic and solder melting liquid which are evaluated by a TCT test as the purpose.

[0005]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, this invention has a reactive functional group in [at least two] one molecule, An epoxy resin composition for semiconductor closure containing a compound which has an anthracene skeleton used as a main skeleton of sealing resin is made into the 1st gist, Make into the 2nd gist a semiconductor device with which a semiconductor device was closed using the above-mentioned epoxy resin composition for semiconductor closure, and let a semiconductor device with which a semiconductor device was closed using an epoxy resin composition for semiconductor closure containing the following (A) - (C) ingredient be the 3rd gist.

(A) following (b) and (**) -- at least -- on the other hand .

(b) dihydroxyanthracene glycidyl ether and trihydroxy anthracene glycidyl ether -- at least -- on the other hand .

(**) Epoxy resins other than the above-mentioned (b).

(B) following (**) and (**) -- at least -- on the other hand [However, when the (A) ingredient consists only of the above-mentioned (**), the (B) ingredient consists of (**)s at least.] .

(**) dihydroxyanthracene and trihydroxy anthracene -- at least -- on the other hand .

(**) Novolac type phenol resin.

(C) Inorganic filler.

[0006]

[Function]That is, this invention persons repeated a series of researches, in order to realize crack resistant improvement at the time of being immersed in the improvement in each characteristic and solder melting liquid which are evaluated by a TCT test. As a result, when the compound which has an anthracene skeleton which is special skeletal structure was used as a main skeleton into sealing resin, it found out coming to excel in the crack resistant both sides at the time of being immersed in the solder melting liquid after a TCT test and moisture

absorption, and this invention was reached.

[0007]Below, this invention is explained in detail.

[0008]The epoxy resin composition for semiconductor closure of this invention contains the compound which has a reactive functional group in [at least two] one molecule, and has an anthracene skeleton used as the main skeleton of sealing resin. As the above-mentioned reactive functional group, what glycidyl-ether-ized the hydroxyl group (-OH) and the hydroxyl group, a primary amino (-NH₂), a carboxyl group (-COOH), or a sulfonic group (-SO₃H) is raised. Specifically, dihydroxyanthracene, trihydroxy anthracene, the thing that glycidyl-ether-ized these, etc. are raised.

[0009]And there are the following four kinds of modes with the combination of the epoxy resin (A ingredient) which constitutes the epoxy resin composition which is a basic component as a concrete composition mode of the epoxy resin composition for semiconductor closure of this invention, and the hardening agent (B ingredient) which constitutes a hardening agent component.

[0010]The 1st mode is the combination of new epoxy resin and usual novolac type phenol resin.

The 2nd mode is the usual epoxy resin and the combination of a new hardening agent, and the 3rd mode, It is the combination of new epoxy resin and a new hardening agent, and the 4th mode is the combination of one of the two of the above-mentioned new epoxy resin and a new hardening agent or both sides, and the usual epoxy resin or usual novolac type phenol resin. The epoxy resin composition which consists of such a combination is the shape of a tablet which was powdered or usually tableted this.

[0011]First, the 1st mode is explained.

[0012]The new epoxy resin which constitutes A ingredient used in the 1st mode of the above is glycidyl ether of dihydroxyanthracene and trihydroxy anthracene.

It is independent or is used collectively.

Specifically 1,2-dihydroxyanthracene, 1,4-dihydroxyanthracene, 9,10-dihydroxyanthracene, 1,2,10-trihydroxy anthracene, 1,8,9-trihydroxy anthracene, and 1,2,7-trihydroxy anthracene are used as a raw material, Poly glycidyl ether is obtained by making these and epichlorohydrin react. Especially, it is preferred to use the weight per epoxy equivalents 128-180 and the thing of 60-130 ** of softening temperatures.

[0013]The usual novolac type phenol resin used with the above-mentioned new epoxy resin acts as a hardening agent of the above-mentioned new epoxy resin.

For example, phenol novolac, cresol novolak resin, etc. are used suitably.

As for these novolak resin, it is preferred that 50-110 ** and a hydroxyl equivalent use the thing of 70-150 in softening temperature. Using phenol novolak resin also in the above-mentioned novolak resin especially brings about a good result.

[0014]As for the compounding ratio of new epoxy resin which is the above-mentioned A ingredient, and novolac type phenol resin of B ingredient, it is preferred to blend so that the hydroxyl group in phenol resin may be 0.8-1.2 Eq per 1 Eq of epoxy groups in the above-mentioned epoxy resin.

[0015]The inorganic filler in particular that is C ingredient used with the above-mentioned new epoxy resin and novolac type phenol resin is not limited, and quartz glass powder, talc, silica powder, alumina powder, etc. which are generally used are raised. It is preferred to use especially silica powder. As for the content of such an inorganic filler, in the case of silica powder, it is preferred to set up more than 50 % of the weight (it omits the following "%") in the whole epoxy resin composition. It is not less than 70% preferably, and is not less than 75% especially preferably. That is, it is because the tendency for the effect containing a bulking agent to fall substantially will be seen if the content of an inorganic filler is less than 50%.

[0016]Below, said 2nd mode is explained.

[0017]Especially if the usual epoxy resin used for said 2nd mode has two or more epoxy groups, it will not restrict to a molecular weight, molecular structure, etc., and a publicly known thing will be used conventionally. For example, a bisphenol A type, a phenol novolac type, a cresolnovolak type, etc. are used. The melting point is over the room temperature also in these resin, and what presents a solid state or hyperviscous solution form brings about a good result under a room temperature. As the above-mentioned novolak type epoxy resin, the weight per epoxy equivalents 160-250 and the thing of 50-130 ** of softening temperatures are used, and, generally the weight per epoxy equivalents 180-210 and the thing of 60-110 ** of softening temperatures are usually used as cresol novolak type epoxy resin.

[0018]The new hardening agents used with the above-mentioned usual epoxy resin are dihydroxyanthracene and trihydroxy anthracene.

These one of the two or both sides are used.

Specifically 1,2-dihydroxyanthracene, 1,4-dihydroxyanthracene, 9,10-dihydroxyanthracene, 1,2,10-trihydroxy anthracene, 1,8,9-trihydroxy anthracene, and 1,2,7-trihydroxy anthracene are raised. These are independent or are used collectively. Especially, hydroxyl equivalents are 70-130 and it is preferred that softening temperature uses what is 70-140 **.

[0019]Also as for the compounding ratio of the above-mentioned usual epoxy resin and a new hardening agent, it is preferred to blend like said 1st mode, so that the hydroxyl group in a new hardening agent may be 0.8-1.2 Eq per 1 Eq of epoxy groups in the above-mentioned usual epoxy resin.

[0020]It is preferred also for the inorganic filler used with an epoxy resin and a new hardening agent usual [above-mentioned] for the same thing as said 1st mode to be raised, and to also set content as the same rate.

[0021]Below, said 3rd mode is explained.

[0022] Said 3rd mode is the combination of new epoxy resin and a new hardening agent. That by which the inorganic filler of C ingredient is used for the above-mentioned new epoxy resin and a new hardening agent pan in said 1st mode and the 2nd mode, and the same thing are raised.

[0023] Said 4th mode is explained.

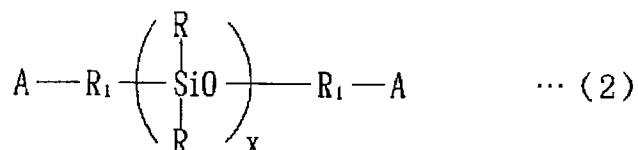
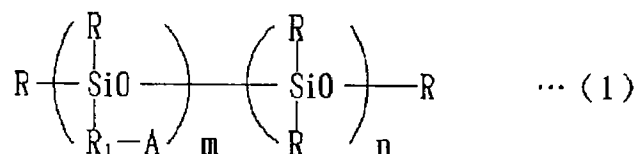
[0024] Said 4th mode is the combination of one of the two of new epoxy resin and a new hardening agent or both sides, and novolac type phenol resin that is the usual epoxy resin or the usual hardening agent. As for the blending ratio of the usual epoxy resin in this case, or usual novolac type phenol resin, it is preferred to set to the whole epoxy resin composition or less than 50% of the whole hardening agent component, respectively.

[0025] And as an inorganic filler used with the above-mentioned epoxy resin composition and a hardening agent component, what is used in said 1st [the] - the 3rd mode, and the same thing are raised.

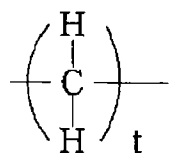
[0026] If a silicone compound is used together in addition to the epoxy resin composition, hardening agent component, and inorganic filler which are used in said 1st [the] - the 4th mode, crack resistance improves and it is much more effective. As the above-mentioned silicone compound, what is expressed with the following general formula (1) and (2) is raised, and it is independent or is used collectively.

[0027]

[Formula 1]



(上記式 (1) および (2) において、Rはメチル基、R₁ は



(ただしtは1～3の整数)、Aはアミノ基、カルボキシル基、水酸基またはシクロヘキセンオキサイド基、mは1～300の整数でnは0または1～300の整数(ただしm+n=1～500の整数)、Xは10～300の整数である。)

[0028]As for the loadings of such a silicone compound, it is preferred to set up so that a silicone compound may turn into 5% or less of the whole epoxy resin composition. It is 0.5 to 3.0% of within the limits especially preferably. That is, it is because the tendency for the characteristics, such as heat resistance, to fall will be seen if the loadings of a silicone compound exceed 5%.

[0029]To the epoxy resin composition for semiconductor closure of this invention. In addition to the epoxy resin composition, the hardening agent component, inorganic filler, and silicone compound which are used in said 1st [the] - the 4th mode, if needed, it is independent or the third class amine conventionally publicly known as a hardening accelerator, quarternary ammonium salt, imidazole derivatives, and a boron compound can be used collectively. Coupling agents, such as fire retardant, such as antimonous oxide and the Lynn system compound, paints, a silane coupling agent, etc. can be used.

[0030]The epoxy resin composition for semiconductor closure of this invention can be manufactured as follows, for example. That is, in addition to the epoxy resin composition, hardening agent component and inorganic filler which are used in the 1st - the 4th mode, and also these, a hardening accelerator, fire retardant, paints, and a coupling agent are blended at a predetermined rate a silicone compound and if needed. Subsequently, after hanging these

mixtures on kneading machines, such as a roll mill machine, carrying out melt kneading by a heated state and cooling this to a room temperature, a publicly known means can grind and the epoxy resin composition for semiconductor closure made into the purpose by a series of processes of tableting if needed can be obtained.

[0031] Closure in particular of the semiconductor device using such an epoxy resin composition cannot be limited, and can be performed with publicly known mold methods, such as the usual transfer molding.

[0032]

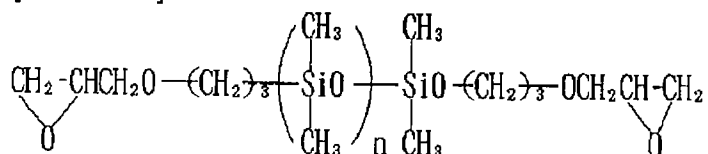
[Effect of the Invention] As mentioned above, since the semiconductor device of this invention is closed using the special epoxy resin composition containing the compound which has a reactive functional group in [at least two] one molecule, and has an anthracene skeleton used as the main skeleton of sealing resin, its characteristic evaluated by a TCT test improves, and it becomes long lasting. After moisture absorption, when immersed in solder melting liquid, it is hard to generate a package crack. the above -- in a not less than 4-mm large-sized semiconductor device, eight or more pins of the above high-reliability come to be especially acquired for 16 or more pins or the long side of a semiconductor device by closure by a special epoxy resin composition, and this is the big feature.

[0033] Below, it combines with a comparative example and an example is described.

[0034] In advance of production of the epoxy resin composition for semiconductor closure, following silicone compound a-f, epoxy resin A-E, and hardening agent F-J were prepared.

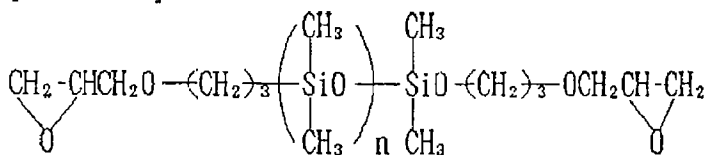
[0035] [Silicone compound a]

[Formula 2]



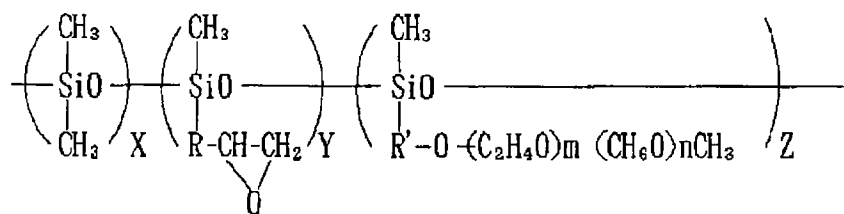
Weight per epoxy equivalent: 1800 [0036] [Silicone compound b]

[Formula 3]



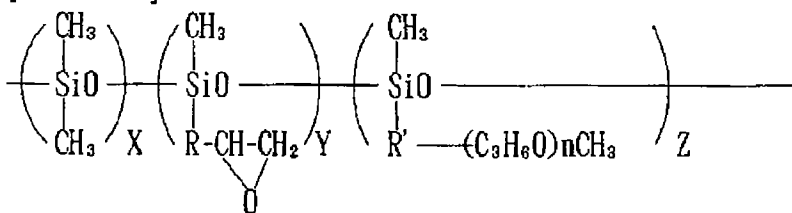
Weight per epoxy equivalent: 3000 [0037] [Silicone compound c]

[Formula 4]



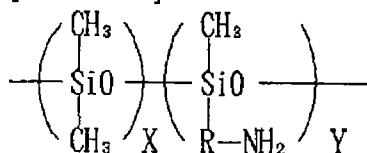
Weight per epoxy equivalent: 10000 [0038][Silicone compound d]

[Formula 5]



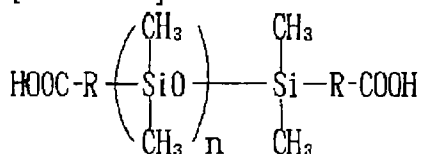
Weight per epoxy equivalent: 7000 [0039][Silicone compound e]

[Formula 6]



Amine equivalent: 3800 [0040][Silicone compound f]

[Formula 7]

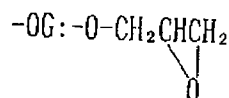
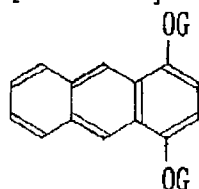


Carboxyl Equivalent: 3300 [0041] In above-mentioned silicone compound a-f, the value of n is [at 40 and silicone compound b / in 60 and silicone compound c / in 9 and silicone compound d] 87 in silicone compound a in 29 and silicone compound f. The value of m is 9 in silicone compound c. The value of X is [at 156 and silicone compound d] 148 in silicone compound c in 152 and silicone compound e. The value of Y is [at 2 and silicone compound d] 3 in silicone compound c in 3 and silicone compound e. The value of Z is 5 in silicone compound c at 4 and silicone compound d.

[0042][Epoxy resin A] o-cresol novolak type epoxy resin (the weight per epoxy equivalent 195, 80 ** of softening temperatures)

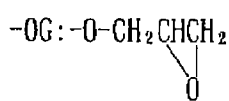
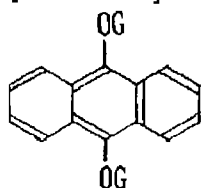
[0043][Epoxy resin B] 1,4-dihydroxyanthracene was used as the raw material and the epoxy resin which makes this and epichlorohydrin react and is expressed with the following structural formula was obtained.

[Formula 8]



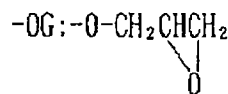
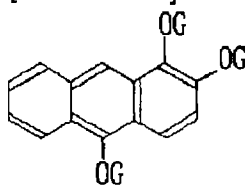
Weight per epoxy equivalent: 161, 110 ** of softening temperatures [0044][Epoxy resin C]
9,10-dihydroxyanthracene was used as the raw material and the epoxy resin which makes this and epichlorohydrin react and is expressed with the following structural formula was obtained.

[Formula 9]



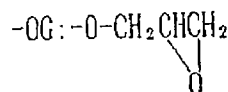
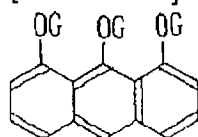
Weight per epoxy equivalent: 161, 110 ** of softening temperatures [0045][Epoxy resin D]
1,2,10-trihydroxy anthracene was used as the raw material, and the epoxy resin which makes this and epichlorohydrin react and is expressed with the following structural formula was obtained.

[Formula 10]



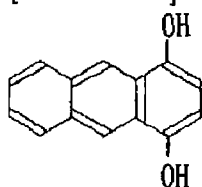
Weight per epoxy equivalent: 128, 100 ** of softening temperatures [0046][Epoxy resin E]
1,8,9-trihydroxy anthracene was used as the raw material, and the epoxy resin which makes this and epichlorohydrin react and is expressed with the following structural formula was obtained.

[Formula 11]



Weight per epoxy equivalent: 128, 100 ** of softening temperatures [0047][Hardening agent F]
Phenol novolak resin (the hydroxyl equivalent 105, 80 ** of softening temperatures)
[0048][Hardening agent G]

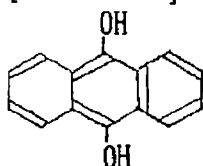
[Formula 12]



1,4-dihydroxyanthracene hydroxyl equivalent: 105, 130 ** of softening temperatures [0049]

[Hardening agent H]

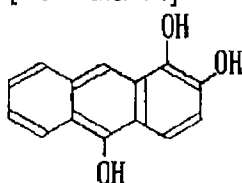
[Formula 13]



9,10-dihydroxyanthracene hydroxyl equivalent: 105, 130 ** of softening temperatures [0050]

[Hardening agent I]

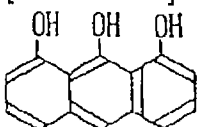
[Formula 14]



1,2,10-trihydroxy anthracene hydroxyl equivalent: 72, 110 ** of softening temperatures [0051]

[Hardening agent J]

[Formula 15]



1,8,10-trihydroxy anthracene hydroxyl equivalent: 72, 110 ** of softening temperatures [0052]

[Examples 1-76, the comparative examples 1-3] Above-mentioned silicone compound a-f, the epoxy resins A-E, and hardening agent F-J, Each ingredient shown in the following Table 1 - 12 was blended at a rate shown in the table, the roll mill machine (temperature of 100 **) performed melt kneading for 3 minutes, and the powdered epoxy resin composition for semiconductor closure which is ground after cooling solidification and made into the purpose was obtained.

[0053]

[Table 1]

(重量部)

		実 施 例					
		1	2	3	4	5	6
エポキシ樹脂	A	—	—	—	—	—	—
	B	100	—	—	—	100	100
	C	—	100	—	—	—	—
	D	—	—	100	—	—	—
	E	—	—	—	100	—	—
硬化剤 F		65	65	82	82	65	65
シリコン化合物	a	—	—	—	—	—	—
	b	—	—	—	—	10	—
	c	—	—	—	—	—	—
	d	—	—	—	—	—	20
	e	—	—	—	—	—	—
	f	—	—	—	—	—	—
トリフェニルホスフィン		3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5
シリカ粉末		620	992	1408	448	656	1430
シリカ粉末含有量 (%)		78	85	88	70	78	88

[0054]

[Table 2]

(重量部)

		実 施 例					
		7	8	9	10	11	12
エポキシ樹脂	A	—	—	—	—	—	—
	B	—	—	—	—	—	—
	C	100	100	—	—	—	—
	D	—	—	100	100	—	—
	E	—	—	—	—	100	100
硬化剤 F		65	65	82	82	82	82
シリコン化合物	a	5	—	—	—	—	—
	b	—	—	—	—	20	—
	c	—	—	10	—	—	—
	d	—	—	—	—	—	5
	e	—	20	—	—	—	—
	f	—	—	—	10	—	—
トリフェニルホスフィン		3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5
シリカ粉末		334	780	471	716	1555	788
シリカ粉末含有量 (%)		65	80	70	78	88	80

[0055]

[Table 3]

(重量部)

		実 施 例					
		1 3	1 4	1 5	1 6	1 7	1 8
エポキシ樹脂 A		100	100	100	100	100	100
硬化剤	F	54	—	—	—	54	54
	G	—	54	—	—	—	—
	H	—	—	37	—	—	—
	I	—	—	—	37	—	—
	J	—	—	—	—	—	—
シリコン化合物	a	—	—	—	—	—	—
	b	—	—	—	—	10	—
	c	—	—	—	—	—	—
	d	—	—	—	—	—	20
	e	—	—	—	—	—	—
	f	—	—	—	—	—	—
トリフェニルホスフィン		3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5
シリカ粉末		581	929	1078	343	617	1349
シリカ粉末含有量 (%)		78	85	88	70	78	88

[0056]

[Table 4]

(重量部)

		実 施 例					
		1 9	2 0	2 1	2 2	2 3	2 4
エポキシ樹脂 A		100	100	100	100	100	100
硬化剤	F	—	—	—	—	—	—
	G	54	54	—	—	—	—
	H	—	—	37	37	—	—
	I	—	—	—	—	37	37
	J	—	—	—	—	—	—
シリコン化合物	a	5	—	—	—	—	—
	b	—	—	—	—	20	—
	c	—	—	10	—	—	—
	d	—	—	—	—	—	5
	e	—	20	—	—	—	—
	f	—	—	—	10	—	—
トリフェニルホスフィン		3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5
シリカ粉末		314	736	366	557	1225	608
シリカ粉末含有量 (%)		65	80	70	78	88	80

[0057]

[Table 5]

(重量部)

		実 施 例					
		2 5	2 6	2 7	2 8	2 9	3 0
エポキシ樹脂	B	100	100	—	—	100	—
	D	—	—	100	100	—	100
硬化剤	G	65	—	82	—	65	—
	I	—	45	—	56	—	56
シリコン化合物	a	—	—	—	—	—	—
	b	—	—	—	—	—	—
	c	—	—	—	—	—	—
	d	—	—	—	—	—	—
	e	—	—	—	—	—	—
	f	—	—	—	—	—	—
トリフェニルホスフィン		3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5
シリカ粉末		613	867	1393	426	1269	581
シリカ粉末含有量 (%)		78	85	88	70	88	78

[0058]

[Table 6]

(重量部)

		実 施 例					
		3 1	3 2	3 3	3 4	3 5	3 6
エポキシ樹脂	B	100	100	—	—	100	—
	D	—	—	100	100	—	100
硬化剤	G	65	—	82	—	65	—
	I	—	45	—	56	—	56
シリコン化合物	a	—	—	5	—	—	—
	b	10	—	—	—	—	—
	c	—	—	—	—	10	—
	d	—	20	—	—	—	5
	e	—	—	—	20	—	—
	f	—	—	—	—	—	—
トリフェニルホスフィン		3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5
シリカ粉末		649	1269	780	1349	427	314
シリカ粉末含有量 (%)		78	88	80	88	70	65

[0059]

[Table 7]

(重量部)

		実 施 例							
		3 7	3 8	3 9	4 0	4 1	4 2	4 3	4 4
エポキシ樹脂	A	50	50	50	50	—	—	20	20
	B	50	—	—	—	50	50	40	40
	C	—	50	—	—	—	—	—	—
	D	—	—	50	—	50	50	40	40
	E	—	—	—	50	—	—	—	—
硬化剤 F		59	59	65	65	73	73	68	68
シリコーン 化合物	a	—	5	—	—	—	—	—	—
	b	—	—	—	20	—	10	—	—
	c	—	—	—	—	—	—	—	—
	d	—	—	—	—	—	—	—	20
	e	—	—	—	—	—	—	—	—
	f	—	—	—	—	—	—	—	—
トリフェニルホス フィン		3	3	3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5	5	5
シリカ粉末		592	319	1269	1415	642	677	1291	1437
シリカ粉末含有量 (%)		78	65	88	88	78	78	88	88

[0060]

[Table 8]

(重量部)

		実 施 例							
		4 5	4 6	4 7	4 8	4 9	5 0	5 1	5 2
エポキシ樹脂 A		100	100	100	100	100	100	100	100
硬化剤	F	24	24	12	12	—	—	14	14
	G	30	—	—	—	30	30	20	20
	H	—	30	—	—	—	—	—	—
	I	—	—	29	—	16	16	14	14
	J	—	—	—	29	—	—	—	—
シリコーン 化合物	a	—	5	—	—	—	5	—	—
	b	—	—	—	20	—	—	—	10
	c	—	—	—	—	—	—	—	—
	d	—	—	—	—	—	—	—	—
	e	—	—	—	—	—	—	—	—
	f	—	—	—	—	—	—	—	—
トリフェニルホス フィン		3	3	3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5	5	5
シリカ粉末		574	310	1092	1239	546	295	553	589
シリカ粉末含有量 (%)		78	65	88	88	78	65	78	78

[0061]

[Table 9]

(重量部)

		実 施 例							
		5 3	5 4	5 5	5 6	5 7	5 8	5 9	6 0
エポキシ樹脂	B	50	50	50	50	100	100	—	—
	D	50	50	50	50	—	—	100	100
硬化剤	G	73	—	73	—	34	34	34	34
	I	—	50	—	50	21	21	33	33
シリコン 化合物	a	—	—	5	—	—	5	—	—
	b	—	—	—	20	—	—	—	20
	c	—	—	—	—	—	—	—	—
	d	—	—	—	—	—	—	—	—
	e	—	—	—	—	—	—	—	—
	f	—	—	—	—	—	—	—	—
トリフェニルホス フィン		3	3	3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5	5	5
シリカ粉末		1026	369	347	1305	578	312	992	780
シリカ粉末含有量 (%)		85	70	65	88	78	65	85	80

[0062]

[Table 10]

(重量部)

		実 施 例			
		6 1	6 2	6 3	6 4
エポキシ樹脂	B	50	50	50	50
	D	50	50	50	50
硬化剤	G	30	25	30	25
	I	29	33	29	33
シリコン化合物	a	—	—	5	—
	b	—	—	—	20
	c	—	—	—	—
	d	—	—	—	—
	e	—	—	—	—
	f	—	—	—	—
トリフェニルホスフィン		3	3	3	3
ステアリン酸		5	5	5	5
シリカ粉末		592	1217	319	1364
シリカ粉末含有量 (%)		78	88	65	88

[0063]

[Table 11]

(重量部)

		実 施 例							
		6 5	6 6	6 7	6 8	6 9	7 0	7 1	7 2
エポキシ樹脂	A	40	40	40	40	40	40	40	40
	B	30	30	30	30	30	30	30	30
	D	30	30	30	30	30	30	30	30
硬化剤	F	10	10	10	10	—	—	—	—
	G	20	15	20	15	30	25	30	25
	I	23	27	23	27	23	27	23	27
シリコーン 化合物	a	—	—	5	—	—	—	5	—
	b	—	—	—	20	—	—	—	20
	c	—	—	—	—	—	—	—	—
	d	—	—	—	—	—	—	—	—
	e	—	—	—	—	—	—	—	—
	f	—	—	—	—	—	—	—	—
トリフェニルホス フィン		3	3	3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5	5	5
シリカ粉末		570	1173	299	1320	571	1173	336	1320
シリカ粉末含有量 (%)		78	88	65	88	78	88	65	88

[0064]

[Table 12]

(重量部)

		実 施 例				比 較 例		
		7 3	7 4	7 5	7 6	1	2	3
エポキシ樹脂	A	—	—	—	—	100	100	100
	B	50	50	50	50	—	—	—
	D	50	50	50	50	—	—	—
硬化剤	F	10	10	10	10	54	54	54
	G	20	15	20	15	—	—	—
	I	20	33	24	40	—	—	—
シリコン化合物	a	—	—	5	—	—	10	—
	b	—	—	—	20	—	—	20
	c	—	—	—	—	—	—	—
	d	—	—	—	—	—	—	—
	e	—	—	—	—	—	—	—
	f	—	—	—	—	—	—	—
トリフェニルホスフィン		3	3	3	3	3	3	3
ステアリン酸		5	5	5	5	5	5	5
シリカ粉末		592	1217	310	1415	581	617	652
シリカ粉末含有量 (%)		78	88	65	88	78	78	78

[0065]The semiconductor device was obtained using the epoxy resin composition for semiconductor closure obtained by the above example and comparative example by carrying out transfer molding (conditions: 175 °C x 2 minutes, 175 °C x 5-hour postcure) of the semiconductor device. This package is 80 pin QFP (a KUODO flat package, size: 20x14x2 mm), and die pad size is 8x8 mm.

[0066]Thus, about the obtained semiconductor device, -50 °C/5 minutes - 150 °C/the thermal excursion test for 5 minutes (TCT test) was done. After making it neglect and absorb moisture in the thermostat of 85 °C/85% relative humidity, the examination immersed in 260 °C solder melting liquid for 10 seconds was done. This result was shown in the following Table 13 - 21.

[0067]

[Table 13]

			実 施 例								
			1	2	3	4	5	6	7	8	9
TCTテストでのクラック発生数 (個/5個)	サイクル数	1000	1	0	0	5	0	0	0	0	0
		2000	5	2	0	—	0	0	2	0	0
		3000	—	5	5	—	0	0	5	0	0
半田浸漬時の耐クラック性試験におけるクラック発生数(個/5個)	吸湿時間	48hr	0	0	0	0	0	0	0	0	0
		72hr	0	0	0	2	0	0	5	0	0
		96hr	0	0	0	5	0	0	—	0	5

[0068]

[Table 14]

			実 施 例								
			10	11	12	13	14	15	16	17	18
TCTテストでの クラック発生数 (個／5個)	サイ クル 数	1000	0	0	0	3	0	0	5	0	0
		2000	0	0	0	5	5	2	0	0	0
		3000	0	0	0	—	—	5	0	0	0
半田浸漬時の耐ク ラック性試験にお けるクラック発生 数(個／5個)	吸 湿 時 間	48hr	0	0	0	0	0	0	0	0	0
		72hr	0	0	0	0	0	0	3	0	0
		96hr	0	0	0	0	0	0	5	0	0

[0069]

[Table 15]

			実 施 例								
			19	20	21	22	23	24	25	26	27
TCTテストでの クラック発生数 (個／5個)	サイ クル 数	1000	2	0	0	0	0	0	0	0	0
		2000	5	0	0	0	0	0	5	0	0
		3000	—	0	0	0	0	0	—	3	3
半田浸漬時の耐ク ラック性試験にお けるクラック発生 数(個／5個)	吸 湿 時 間	48hr	1	0	0	0	0	0	0	0	0
		72hr	5	0	2	0	0	0	0	0	0
		96hr	—	0	5	0	0	0	0	0	0

[0070]

[Table 16]

			実 施 例								
			28	29	30	31	32	33	34	35	36
TCTテストでの クラック発生数 (個／5個)	サイクル数	1000	2	0	0	0	0	0	0	0	0
		2000	5	0	0	0	0	0	0	0	0
		3000	—	1	2	0	0	0	0	0	0
半田浸漬時の耐ク ラック性試験にお けるクラック発生 数(個／5個)	吸湿時間	48hr	0	0	0	0	0	0	0	0	0
		72hr	0	0	0	0	0	0	0	0	5
		96hr	2	0	0	0	0	0	0	2	—

[0071]

[Table 17]

			実 施 例								
			37	38	39	40	41	42	43	44	45
TCTテストでの クラック発生数 (個／5個)	サイ クル 数	1000	1	0	0	0	0	0	0	0	2
		2000	5	2	0	0	5	0	0	0	5
		3000	—	5	5	0	—	0	5	0	—
半田浸漬時の耐ク ラック性試験にお けるクラック発生 数 (個／5個)	吸 湿 時 間	48hr	0	0	0	0	0	0	0	0	0
		72hr	0	5	0	0	0	0	0	0	0
		96hr	0	—	0	0	0	0	0	0	0

[0072]

[Table 18]

			実 施 例								
			46	47	48	49	50	51	52	53	54
TCTテストでの クラック発生数 (個／5個)	サイ クル 数	1000	2	0	0	1	3	1	0	0	0
		2000	5	1	0	5	5	5	0	0	3
		3000	—	5	0	—	—	—	0	3	5
半田浸漬時の耐ク ラック性試験にお けるクラック発生 数 (個／5個)	吸 湿 時 間	48hr	3	0	0	0	1	0	0	0	1
		72hr	5	0	0	0	5	0	0	0	5
		96hr	—	0	0	0	—	0	0	0	—

[0073]

[Table 19]

			実 施 例								
			55	56	57	58	59	60	61	62	63
TCTテストでの クラック発生数 (個／5個)	サイ クル 数	1000	1	0	0	3	0	0	0	0	0
		2000	5	0	0	5	0	0	5	3	0
		3000	—	0	3	—	2	0	—	5	2
半田浸漬時の耐ク ラック性試験にお けるクラック発生 数 (個／5個)	吸 湿 時 間	48hr	0	0	0	0	0	0	0	0	0
		72hr	2	0	0	3	0	0	0	0	3
		96hr	5	0	0	5	0	0	0	0	5

[0074]

[Table 20]

			実 施 例								
			64	65	66	67	68	69	70	71	72
TCTテストでのクラック発生数 (個／5個)	サイクル数	1000	0	0	0	0	0	0	0	0	0
		2000	0	3	1	1	0	3	0	2	0
		3000	0	5	5	5	0	5	2	5	0
半田浸漬時の耐クラック性試験におけるクラック発生数 (個／5個)	吸湿時間	48hr	0	0	0	0	0	0	0	0	0
		72hr	0	0	0	0	0	0	0	1	0
		96hr	0	0	0	5	0	0	0	5	0

[0075]

[Table 21]

			実 施 例				比較例		
			73	74	75	76	1	2	3
TCTテストでのクラック発生数 (個／5個)	サイクル数	1000	0	0	0	0	5	5	5
		2000	0	0	1	0	—	—	—
		3000	5	1	5	0	—	—	—
半田浸漬時の耐クラック性試験におけるクラック発生数 (個／5個)	吸湿時間	48hr	0	0	0	0	5	5	5
		72hr	0	0	2	0	—	—	—
		96hr	0	0	5	0	—	—	—

[0076] It turns out that the crack resistance at the time of the immersion to the TCT test and solder melting liquid of an example article from the result of above-mentioned Table 13 - 21 is remarkably excellent conventionally [which is a comparative example] compared with elegance.

[Translation done.]